INTERMOUNTAIN STATION
Central Reference File
No. 0.73

FOREST SERVICE
RECEIVED
MAY 31 1938
RESEARCH
INTERMOUNTAIN

APPLIED FORESTRY NOTES

NORTHERN ROCKY MOUNTAIN
FOREST AND RANGE EXPERIMENT STATION

No. 85 Missoula, Montana May 1938

THE NORTHERN ROCKY MOUNTAIN FIRE DANGER METER, MODEL NO. 5

By H. T. Gisborne, In Charge, Division Forest Protection

In 1931 the Northern Rocky Mountain Forest and Range Experiment Station first proposed the integration of fire danger factors into a numerical scale of danger by use of a device called a fire danger meter. After four years of field tests and development, on 10 National Forests in Region One, model no. 4 was designed and judged satisfactory for official use in standardizing the classification of fire danger and as a basis for determining the size of the fire control organization needed to meet current fire danger.

Model no. 4 was used without change during the three-year period 1935 to 1937, inclusive. Meanwhile a file record was accumulated showing specific cases of both desirable and possible refinements. One desired change, the incorporation of vegetative condition such as the greenness and luxuriance of grasses, weeds, and shrubs, was studied intensively during this period but even yet no sufficiently accurate method has been found to warrant substitution for calendar date. It is believed that in some seasons this low vegetation, which is present in material quantities in the more open forest types, matures earlier than usual or stays green longer than usual and thereby accelerates fire sooner or retards it later than indicated by the calendar date index of this phenological process. This is the exceptional rather than the normal case, however, and on fully timbered areas the condition of vegetation is entirely immaterial because on such sites this type of fuel is so sparse, or entirely lacking, that it is not at all a factor in rate of spread of fire. As the other factors of danger are being quite accurately measured the danger

rating scheme would be materially weakened by incorporating an index which could not be similarly measured. This desired refinement, therefore, must wait upon further research.

The file record for 1935 to 1937 disclosed, however, certain other modifications of the model 4 meter which were both desirable and possible. This record showed that two of the 112 danger ratings carried on slide B were definitely out of line with adjacent ratings and that one other was clearly open to question. The 112 ratings were therefore plotted graphically, by columns and lines, in an attempt to smooth out these three known and other suspected irregularities. This had been tried before but without success so long as danger was expressed in only seven classes.

The new smoothing was aided by Regional Office and National Forest recognition of the fact that whereas seven classes of danger had seemed, in 1931 and 1932, to be extreme refinement, continued use had disclosed that further refinement was not only possible but decidedly practicable. Field men had learned, in this three-year period, that there is a real difference in fire behavior and in manpower needs between a low class 4 and a high class 4, for example. Such a statement would have been ridiculed in 1932, when even seven classes of danger were characterized as "hair splitting." By 1937, however, old-time rangers were reporting "low class 5, middle class 5, and high class 5 danger" and they were manning more lookout and guard stations for high 5 than for low 5 danger. Obviously, they were ready for danger measured by tenths of classes.

When the 112 ratings, in seven classes, carried by slide B, were graded smoothly by tenths of classes and plotted graphically, the three known irregularities became clearly evident. Others, previously unsuspected, also became apparent although only nine other cases, out of the 112, warranted changing to a different whole class of danger. This smoothing and correcting process therefore resulted in changing only 12 of the 112 previous ratings. The changes in all cases were to lower danger, which was to be expected, because the original ratings had been made, intentionally, to over-rate rather than underrate whenever there was any doubt concerning the effect of a particular combination of factors.

The new model 5 meter consequently gives somewhat lower ratings of danger than were given by model 4. The new ratings are, however, very definitely more consistent for all possible combinations of factors, and more accurate throughout the entire scale. They are also more conservative, and, happily, more economical of fire control funds. In fact, one entirely unforeseen result of this research will be a saving of fire control funds more than sufficient to pay for all the costs of measuring fire danger. The 1937 records for two Forests, on which the new meter was recently tested, show, for example, that by the new ratings 310 man-days of lookout or smokechaser labor would have been saved on one

Forest and 558 man-days on the other. While the former is only 4.7% and the latter is 7.3% of the total July-August fire control labor warranted by the old meter, the reduced cost far more than offsets all the time given on either Forest to fire danger measurement.

The new, smoothed ratings consequently refine the definition of danger to the nearest tenth of a class and at the same time, by improved accuracy, "pay for their cost" perhaps several times over. If 100 of the original 112 ratings were such as to give adequate protection, the lowering of 12 cases should not in the least contribute to underrating danger and over-exposing the Forests to damage. As three years of trial produced no evidence of general underrating the new meter is believed to be entirely safe even though materially more economical.

The second major refinement in the model 5 meter consists of a changed scale of visibility distance for the western Montana and North Idaho Forests, and the addition of a new scale for the central and eastern Montana Forests. These alterations result in economy on the eastern Forests and improved efficiency on the western. In a few cases, on the western Forests, the new scale results in raising the danger rating when visibility is between 1.1 and 3.9 miles, but these are considered in the statement of economy previously made.

A third change consists of the removal of the former specifications as to manning the fire control organization commensurate with each class of danger, and the substitution of a mere reference to the fire control plans for such detail. The former specifications served admirably to illustrate the fact that danger is measured only to indicate what should be done about it, and that danger measurement is but the first step in efficient fire control. No compact device like a danger meter could hope, however, to contain the detailed statements of organization action warranted by each class or fraction of a class of danger. The model 5 meter therefore refers the user to the detailed plans.

Other minor refinements include more exact specification of the limits of each group of fuel moistures and wind velocities, a new tabulation of rate of spread of fire by fire danger class and by fuel type classes, and a new special provision to prevent low visibility due to fog alone from raising the danger rating.

Copies of the new model 5 meter are available, without charge, to all forest protective agencies, forest school faculties, and other cooperators. This meter should not be used, however, in other regions of timber type, fuel type, climate, and weather different from those of the Northern Rocky Mountains. Other Forest Experiment Stations have produced or are evolving meters, danger boards, or other similar devices employing factors and integrations specifically suited to local conditions in other regions.